Hazard Elimination Project Evaluation

Project Log # 200502098

Hazard Elimination Project W-3803

Evaluation of the Guardrail Installations at Fifteen Locations and Curve Improvements At Five Locations on NC 18 Between SR 1541 (Mountain Valley Church Road) and SR 1728 (Long Bottom Road) in Wilkes County

Documents Prepared By:

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_____ 5/18/2006_____
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Hazard Elimination Project Evaluation Documentation

Subject Location

Evaluation of Hazard Elimination Project W-3803 –
Select Locations on NC 18 between SR 1541 (Mountain Valley Church Road) and SR 1728 (Long Bottom Road), in Wilkes County.

Project Information and Background from the Project File Folder

According to the project file folder, the project contained the following safety countermeasures:

Curve Improvements (Removal of Embankment) at the following five locations:

Location B: Vicinity of Kilby Hill
Estimated Cost of $26,000

Location D: North of Freedom Baptist Church
Estimated Cost of $35,000

Location E: At Hall's Mill Community Center
Estimated Cost of $35,000

Location F: North of SR 1573 (Scene of 1/20/1997 Fatalities)
Estimated Cost of $115,000

Location I: Vicinity of Chastine Property
Estimated Cost of $25,000

Total Estimated Cost of Curve Improvements: $236,000.

Guardrail Installations at the following fifteen locations:

Location 1: Vicinity of Kilby Hill; 1450' Length; Right Side*
Estimated Cost of $30,000

Location 3: Vicinity of SR 1570; 850' Length; Right Side
Estimated Cost of $16,000

Location 8: South of SR 1722 (Culvert); 310' Length; Right Side
Estimated Cost of $9,000

Location 9: Opposite of SR 1722 (Culvert); 465' Length; Left Side
Estimated Cost of $11,000

Location 10: North of SR 1722; 240' Length; Right Side
Estimated Cost of $8,000

Location 11: Near Freedom Baptist Church; 650' Length; Left Side
Estimated Cost of $13,000

Location 12: Near Freedom Baptist Church; 900' Length; Left Side
Estimated Cost of $16,000

Location 13: South of Hall's Mill Community Center; 275' Length; Left Side
Estimated Cost of $7,000

Location 14: North of Hall's Mill Community Center; 330' Length; Left Side
Estimated Cost of $7,000

Location 15: Vicinity of SR 1573 (Culvert); 425' Length; Left Side
Estimated Cost of $10,000

Location 16: Vicinity of SR 1573 (Culvert); 230' Length; Right Side
Estimated Cost of $7,000

Location 17: North of SR 1573 (At 1/20/97 Fatal Crash); 775' Length; Right Side
Estimated Cost of $12,000

Location 18: North of 1/20/97 Crash Scene; 570' Length; Right Side
Estimated Cost of $12,000

Location 19: North of 1/20/97 Crash Scene; 220' Length; Right Side
Estimated Cost of $6,000

Location 25: North of SR 1725; 930' Length; Right Side
Estimated Cost of $16,000

Total Estimated Cost of Guardrail Installations: $180,000.
*Left Side or Right Side Guardrail placements are intended for northbound travelling vehicles.

NC 18 is a two-lane, two-way rural mountain road with narrow shoulders, high fill sections, and poor alignment. The pavement width varies from 18 feet to 20 feet at the treatment location. The speed limit is 55 mph. Curve warning signs and chevrons are provided at various locations along the roadway. The treatment was intended to reduce the number and severity of injury crashes caused by vehicles running off the road. It was felt that vehicles were running off the roadway due to the poor roadway alignment, narrow shoulder widths, minimal guardrail placement, and horizontal curves with restricted sight. The project was completed on July 20, 1998 at a cost of $460,000.

The initial crash analysis was completed on NC 18 from 0.5 miles north of SR 1540 to SR 1728. The initial study time period was from November 1, 1994 through October 31, 1997. According to the initial analysis, there were 37 Total Crashes. This included 4 Ran-Off-Road crashes in fill sections, 16 Ran-Off-Road crashes in cut and fill sections, 1 Sideswipe crash in a horizontal curve, 10 Animal crashes, and 6 Random crashes. The guardrail was installed to alleviate the pattern of Ran-Off-Road crashes in fill sections. The curve improvements were intended to alleviate the pattern of sideswipe crashes in horizontal curves. The other crashes were not seen as correctable by the proposed treatments.

Twenty crashes in the initial analysis involved vehicles running off the road. As part of the treatment, guardrail was installed at four of the locations where ran off road crashes occurred. The guardrail was expected to reduce the severity of 50 percent of the injury crashes, eliminate the other 50 percent of the injury crashes, and eliminate 50 percent of the property damage only crashes. It was felt that the guardrail installations would eliminate the crashes by delineating the hazard.

One fatal crash occurred in the initial crash analysis on January 20, 1997. This crash involved a logging truck with improper vehicle equipment that was travelling downgrade at an excessive speed and encroached into the opposing lane. The truck struck an oncoming vehicle, resulting in five fatalities. As recommended from the fatal accident investigation, additional curve warning signs were placed in advance of the curve where the crash occurred and chevrons were installed along the curve for both directions of travel. According to the project file folder, a 20 percent reduction of this crash type was assumed by the treatments.

Naive Before and After Analysis

After reviewing the project file folder along with all the crashes at the subject location, the crash data omitted from this analysis to consider for an adequate construction period was from June 1, 1998 through August 31, 1998. The before period consisted of reported crashes from June 1, 1991 through May 31, 1998 (7 Years) and the after period consisted of reported crashes from September 1, 1998 through August 31, 2005 (7 Years). The ending date for this analysis was determined by the available crash data at the time the crash analysis was completed.

The treatment data consisted of all crashes on the 7.23-mile strip of NC 18 from SR 1541-Mountain Valley Church Road to SR 1728-Long Bottom Road. A 0 feet Y-line was used in the analysis and only mainline crashes were included. Please see attached *Location Map* for further detail.

The following data Table 1 depicts the Naive Before and After Analysis for the Total Crashes and Target Crashes at the treatment location. Table 2 provides an in depth examination of the Naïve Before and After Analysis for the Target Crashes. Please note that Target Crashes include the following crash types: Ran Off Road - Right, Ran Off Road - Left, Ran Off Road - Straight, Overturn/Rollover, Fixed Object, Head On, Sideswipe - Same Direction, and Sideswipe - Opposite Direction. Target Crashes are all potential Run-Off-Road crashes and include those crash types where at least one vehicle was involved in a lane departure.

Table 3, on the next page, provides data on the Target Crashes that were influenced by the treatment. The Influenced Crashes are those Target Crashes where a specific location treatment either would have had an impact on the crash (referring to before period crashes) or did have a direct impact on the crash (referring to after period crashes). The specific crashes influenced by the treatment are provided and separated by location.

Table 1. Treatment Information	Before Period	After Period	Percent Reduction (-)/ Percent Increase (+)
Total Crashes	95	100	**5.3**
Total Severity Index	13.87	8.51	-38.6
Total Target Crashes	46	40	**-13.0**
Target Severity Index	20.37	16.81	-17.5
Volume	2200	2400	9.1

Table 2. Target Crash Information	Before Period	After Period	Percent Reduction (-)/ Percent Increase (+)
Target Crashes- Injuries			
Fatal Injury Crashes	2	2	0.0
Non-Fatal Injury Crashes	26	28	7.7
Total Injury Crashes	28	30	7.1
Target Crashes-Contributing Factors			
Night Crashes	**17**	**15**	-11.8
Wet Crashes	4	3	-25.0
Alcohol/ Drug Crashes	**7**	**7**	0.0
Target Crashes- Crash Types			
Ran Off Road	39	10	-74.4
Fixed Object	0	19	N/A
Sideswipe, Same Direction	2	0	-100.0
Sideswipe, Opposite Direction	5	3	-40.0
Head On	0	3	N/A
Overturn / Rollover	0	5	N/A
Target Crashes			
Crashes in Horizontal Curves	28	25	-10.7
Guardrail Struck	0	9	N/A

Table 3. Target Crashes Influenced by Treatment

Location	Before		After		
	Crash Number *	Influenced Crashes	Crash Number *	Influenced Crashes	
Guardrail 1	2,3,4,5	4	1,2	2	
Curve B	5,6	2	3	1	
Guardrail 3	n/a	0	n/a	0	
Guardrail 8	17	1	n/a	0	
Guardrail 9	n/a	0	n/a	0	
Guardrail 10	18	1	17	1	
Guardrail 11	21,22	2	n/a	0	
Curve D	23	1	21	1	
Guardrail 12	24	1	22,23	2	
Guardrail 13	n/a	0	n/a	0	
Curve E	30	1	26,27,28	3	
Guardrail 14	n/a	0	n/a	0	
Guardrail 15	31	1	n/a	0	
Guardrail 16	n/a	0	25	1	
Guardrail 17	33,34,35	3	n/a	0	
Curve F	33,34,35	3	n/a	0	
Guardrail 18	n/a	0	n/a	0	
Guardrail 19	36	1	n/a	0	
Curve I	39	1	n/a	0	
Guardrail 25	44	1	n/a	0	Percent Reduction (-)/ Percent Increase (+)
Total Influenced Crashes		19		11	**-42.1**
Influenced Crash Severity Index		31.65		18.82	-40.5

* Crash Number refers to the crash number located on the Before and After Period Collision Diagrams and Target Strip Analysis Reports.

The naive before and after analysis at the treatment location resulted in a 5.3 percent increase in Total Crashes, a 13.0 percent decrease in Target Crashes, and a 42.1 percent decrease in Influenced Crashes. There was also a 38.6 percent decrease in the Total Severity Index, a 17.5 percent decrease in the Target Severity Index, and a 40.5 percent decrease in the Influenced Severity Index. The treatment location experienced a 9.1 percent increase in Average Daily Traffic (ADT). The before period ADT year was 1994 and the after period ADT year was 2002.

Results and Discussion

The naive before and after analysis involving the comparison of treatment actual before data versus treatment actual after data resulted in a 5.3 percent increase in Total Crashes, a 13.0 percent decrease in Target Crashes, and a 42.1 percent decrease in Influenced Crashes. The Total Severity Index decreased by 38.6 percent, the Target Severity Index decreased by 17.5 percent, and the Influenced Severity Index decreased by 40.5 percent. The summary results above demonstrate that the treatment location appears to have had an increase in the number of Total Crashes from the before to the after period. However, the number of both Target and Influenced Crashes appears to have decreased. The Severity Index of Total, Target, and Influenced Crashes also appears to have decreased from the before to the after period.

Analysis of the Target Crashes reveals the following. Although the Target Severity Index decreased, the number of Target Injury Crashes increased (by 7.1 percent) from 28 crashes in the before period to 30 crashes in the after period. This included 2 fatal crashes in both the before and the after periods. All of the fatal Target Crashes occurred within a horizontal curve. Also noteworthy is the fact that approximately 37 percent of all of Target Crashes in the before and after period occurred at night. There were 17 before period nighttime crashes and 15 after period nighttime crashes.

The number of Ran Off Road Target Crashes decreased by 74.4 percent from 39 in the before period to 10 in the after period. However, the number of Fixed Object Target Crashes (all involving a vehicle running off the road) increased from no crashes in the before period to 19 crashes in the after period. In addition, the number of guardrail hits increased from no crashes in the before period to 9 crashes in the after period. (Note that this number includes all guardrail hits along this section of roadway and is not exclusive to the treatment guardrail only.) Also, the number of crashes along this section that occurred in a horizontal curve decreased by 10.7 percent from 28 crashes in the before period to 25 crashes in the after period.

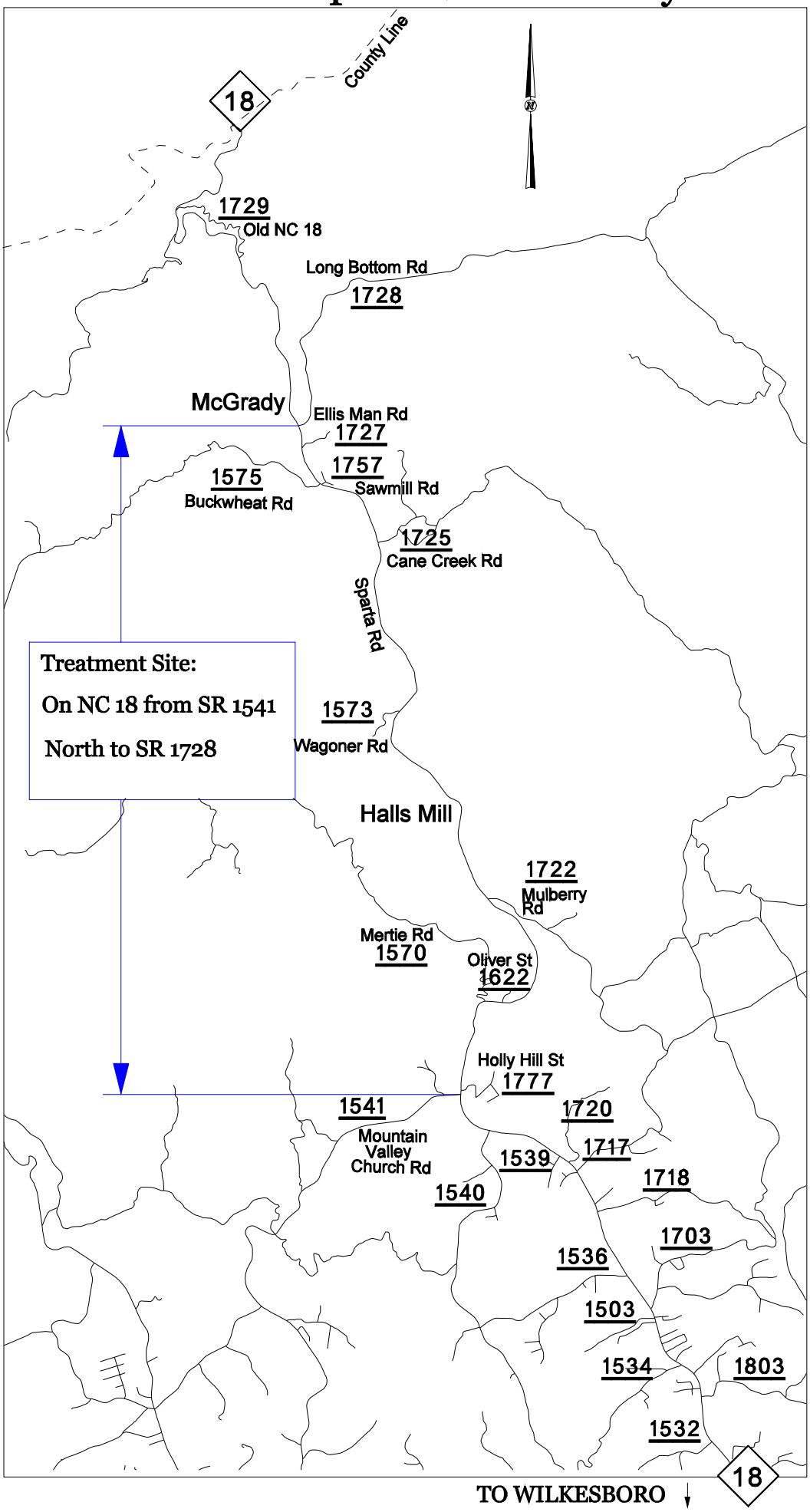
Target Crashes do not provide a completely precise method in which to measure the effectiveness of the guardrail installed and the curve improvements completed under this project. While Target Crashes provide a good picture of what is happening along the entire 7.23-mile section of roadway, they fail to provide data specific to the actual treatment locations. The Influenced Crashes provide a better measure of effectiveness that is more closely related to the objective of the treatment being evaluated. They provide a more meaningful measure of the degree to which the real objective has been achieved.

Analysis of the Influenced Crashes reveals the following. The guardrail installations were intended to reduce the severity of the Ran-Off-Road crashes at specific locations. In the before period, 15 Target Crashes occurred at the guardrail installation locations and would have been influenced by the treatment (meaning the guardrail probably would have been struck). In the after period, 6 Target Crashes involved the treatment guardrail being struck. The curve improvements involved the removal of embankment at locations where the embankment was close to the pavement edge and was intended to improve sight distance and widen the shoulders. Target Crashes that occurred within the treatment curves were also included in the Influenced Crashes. The number of Influenced Crashes that occurred within the treatment curves decreased by 37.5 percent from 8 crashes in the before period to 5 crashes in the after period. The total number of Influenced Crashes decreased by 42.1 percent from 19 crashes in the before period to 11 crashes in the after period.

The severity of Influenced Crashes was also reduced from the before to the after period. The number of Influenced Injury Crashes decreased (by 50.0 percent) from 14 injury crashes in before period to 8 injury crashes in the after period. In the before period, Influenced Crashes resulted in 2 fatal injury crashes, 5 class A injury crashes, 1 class B injury crash, and 6 class C injury crashes. In the after period, Influenced Crashes resulted in 1 fatal injury crash, 1 class A injury crash, 2 class B injury crashes, and 4 class C injury crashes. The after period fatal injury crash occurred in Curve E and involved a passing vehicle hitting an oncoming vehicle around the curve. The after period A injury crash involved a vehicle running off the road and striking Guardrail 12. Both B injury crashes involved vehicles striking Guardrail 1, one after running off the road and the other after a head on collision. Although the number and severity of Influenced Crashes decreased from the before to the after period, a high percentage of the after period crashes still resulted in severe injury crashes.

Please see the attached Treatment Site Photos for additional visual information. As the Safety Evaluation Group completes additional spot safety reviews for this type of countermeasure, we will be able to provide objective and definite information regarding actual crash reduction factors for this type of road.

Hazard Elimination Project W3803
Location Map • Wilkes County



Treatment Site Photos (Taken on January 12, 2006)

Driving North on NC 18 approaching Guardrail Location 1. Notice the Warning Signs above.

Driving North on NC 18 at Curve Improvement B & Guardrail Location 1.

Driving North at Guardrail Location 1, near SR 1570-Mertie Road.

Treatment Site Photos (Taken on January 12, 2006)

Driving North on NC 18 at Guardrail Location 3.

Driving North on NC 18 at Guardrail Location 8, 9, and 10 (surrounding SR 1722).

Driving North on NC 18 at Guardrail Location 8, 9, and 10 (surrounding SR 1722).

Treatment Site Photos (Taken on January 12, 2006)

Driving North on NC 18 at Guardrail Location 11.

Driving North on NC 18 at Guardrail Location 11. Notice the Warning Sign above.

Driving North on NC 18 at Guardrail Locations 11 and 12.

Treatment Site Photos (Taken on January 12, 2006)

Driving North on NC 18 at Guardrail Location 12 and Curve Improvement D.

Driving North on NC 18 at Guardrail Location 12 and Curve Improvement D.

Driving North on NC 18 at Guardrail Location 13.

Treatment Site Photos (Taken on January 12, 2006)

Driving North on NC 18 at Guardrail Location 13 and Curve Improvement E.

Driving North on NC 18 at Guardrail Location 14.

Driving North on NC 18 approaching Guardrail Location 15. Notice Warning Sign above.

Treatment Site Photos (Taken on January 12, 2006)

Driving South on NC 18 approaching Guardrail Locations 15 and 16, near SR 1573.

Driving North on NC 18 at Guardrail Location 17. Notice the Warning Sign above.

Driving North on NC 18 at Guardrail Location 17 and Curve Improvement F.
Notice the chevrons above.

Treatment Site Photos (Taken on January 12, 2006)

Driving North on NC 18 at Guardrail Location 18 and Curve Improvement F.

Driving North on NC 18 at Guardrail Location 18. Notice the Warning Sign above.

Driving North on NC 18 at Guardrail Location 19.

Treatment Site Photos (Taken on January 12, 2006)

Driving North on NC 18 at Curve Improvement I.

Driving North on NC 18 approaching Guardrail Location 25. Notice the Warning Sign above.

Driving North on NC 18 at Guardrail Location 25.

Treatment Site Photos (Taken on January 12, 2006)

Driving North on NC 18 at Guardrail Location 25.

Driving North on NC 18 at Guardrail Location 25, near SR 1757 / SR 1575.

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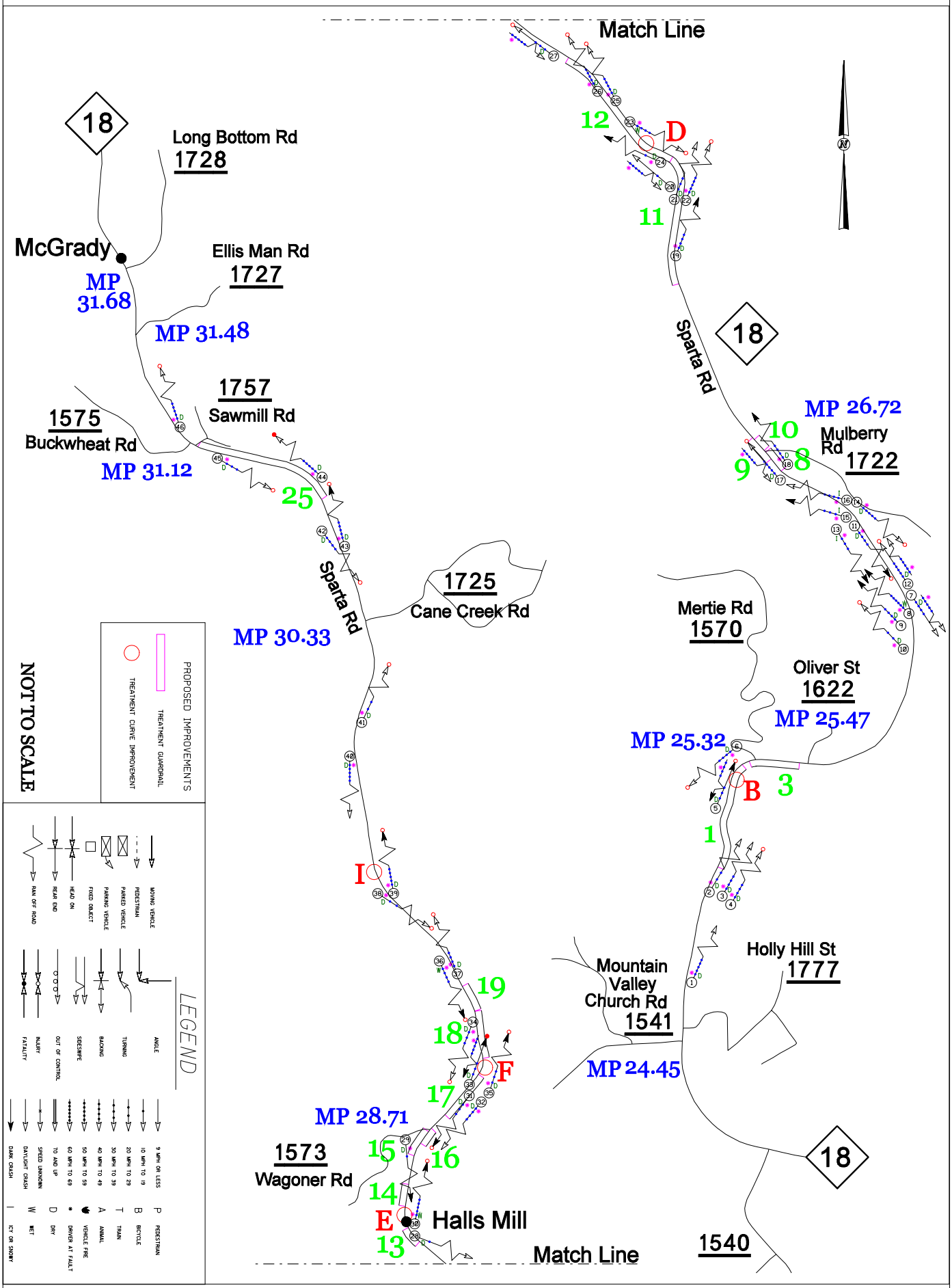
Before Period Collision Diagram - Target Crashes

Wilkes County

June 1, 1991 - May 31, 1998



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After Period Collision Diagram - Target Crashes

Wilkes County

September 1, 1998 - August 31, 2005